SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION
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June 10, 2014

TO: All Engineering Criteria Review Board Members

FROM: Lawrence J. Goldzband, Executive Director (415/352-3611 lgodzband@bcdc.ca.gov)
Rafael Montes, Senior (Staff) Engineer (415/352-3670 rafaelm@bcdc.ca.gov)

SUBJECT: Approved Minutes of December 5, 2012 Engineering Criteria Review Board Meeting

1. **Call to Order.** The meeting was called to order by the Chairman Dr. Roger Borcherdt at approximately 1:30 p.m., in the McAteer-Petris Room, 50 California Street, Suite 2600, San Francisco, California.

2. **Roll Call.** The following Board Members were present: Dr. Roger Borcherdt, Board Chairman, Mr. Maurice Power, G.E., Mr. Frank Rollo, G.E., Ms. Mary Comerio (Architect), Dr. Lou Gilpin, Mr. Richard Dornhelm, P.E. and Mr. George Fotinos, S.E.. The members of the staff present were Mr. John Bowers, Staff Counsel, Mr. Joe LaClair, BCDC Chief of Planning, who was there to answer any questions regarding the newly adopted sea level rise policies and Mr. Rafael Montes, Staff Engineer and Board Secretary. Besides approval of the February 2012 minutes, the agenda included the review and discussion of two projects by the Board.

3. **Approval of the Meeting Summary of February 16, 2012.** Chair Borcherdt solicited comments from the Board members regarding the February 16, 2012 Board's meeting. Mr. Rollo abstained from voting on the minutes due to his non-involvement in and recusal of that project's meeting. There were no further comments. Mr. Power made a motion to approve the minutes seconded by Mr. George Fotinos. The Chair entertained the motion and the minutes were approved by a voice vote. The Board approved unanimously the February 16, 2012 minutes.

4. **Board Discussion of the Proposed Replacement of the Bon Air Road Bridge by the City of Larkspur.** Mr. Bob Cermak with Parsons Brinckerhoff (PB) introduced the City of Larkspur's Director of Public Works, Mr. Hamid Shamsapour, who thanked the Board for the time to review and discuss the bridge project over Corte Madera Creek. Mr. Shamsapour's introduction was followed by Mr. Larry Johnson of PB and structural designer of the Bon Air Road Bridge, Mr. Han-Bin Liang a WRECO subconsultant, hydraulics engineer for the project, Mr. Tom Lee, geotechnical engineer with PB and Mr. Ali Seyed Madani, project engineer with PB. The public audience consisted of Ms. Ellen Johnck, who was also here to participate in the second item of discussion.

Chair Borcherdt asked the prospective applicant to present his project presentation plan. Mr. Cermak proposed to do the project presentation to be then followed by discussion. He indicated the presentation would cover three topics pertaining to engineering criteria concerning structural design, geotechnical and soils, and hydraulics and sea level rise.

The bridge was originally built in 1958. In 1964 there was a seismic retrofit that included a widening to add a Class I bike lane on the north side of the bridge. Since that time, a Caltrans' assessment identified several deficiencies in the structure resulting in a downgrading of the bridge to the classification of "structurally deficient." This category issued by the State mandates the replacement of the structure for safety reasons. During an inspection in October 2012, Caltrans inspectors identified serious flaws on the structure that alerted the City to take immediate actions to safeguard it. As a result, the City enacted physical measures to shore up the bridge. The bridge is a major thoroughfare for the City of Larkspur linking the area to Highway 101 and to the General Hospital. Mr. Cermak deferred the structural criteria details of the project to Mr. Seyed Madani.

Mr. Seyed-Madani described the existing bridge as a ten-span steel structure. Its alignment is on a slight curb; therefore, one of the objectives was to straighten its alignment to match with the water flow and further widen the bridge to take a second Class I bicycle lane. He reiterated the urgency of replacing the existing bridge describing the last emergency some weeks ago when the underdeck girders were unseating away from the supporting caps, a condition that posed a great risk prompting emergency repairs or face a mandated closure by Caltrans if not repaired within 60 days of notice.

During description of project, he noted that the proposed construction staging would require the continuation of traffic service capacity through construction. The north side of the bridge of the bridge would be removed first, allowing traffic to continue on the south side. The new bridge would have less foundation elements in the creek and would realign the pier with the water flow so as to improve conveyance and connectivity between creek flow and piers. The number of columns would be reduced to just four bents with two columns each versus the original nine bents with seven columns each. The bridge would be built in two sections with a pier column supporting each half of the bridge. The two sections of the new bridge would be separated by symmetrical structures acting independently and connected by a seismic joint at the center line of the bridge. He described the main components of the structure as having cast-in-drilled-hole (CIDH) foundations, cast-in-place pier caps, and cast-in-place column precast girders.

Mr. Seyed-Madani enumerated the design codes and standards to be complied with. All of these are based on the required Caltrans bridge design criteria. The "acceptance criteria" classifies this structure as an "ordinary standard bridge" where service loads meet an elastic design (no permanent deformation), and the seismic loads meet a plastic design and no collapse criteria or no-catastrophic failure scheme. For the seismic loads, the superstructure would remain elastic; the substructure as far as the pier caps would also remain elastic. The piles/columns connection would form a plastic hinge, and the abutment backwalls would be allowed to fail since these are

easier to repair after an earthquake. The piles would also remain elastic during loading. He showed the proposed load combinations to follow load and resistance factor design (LRFD) specifications where a water load has been taken into account as specified by the code. The water loads were estimated to be about 9 to 10 pounds per foot squared of the surface due to the low velocity of water at the creek compared to about 50 pounds per foot squared of wind loads. He now deferred the geotechnical and soils presentation to Mr. Tom Lee.

Mr. Lee showed a slide of the site of the project with respect to a geology map of the area where surficial deposits marked by artificial fill over marine and marsh deposits surround the area of the project. His second slide presented the area in relation to its proximity to the nearest earthquake faults: the San Andreas (12.3 Km west) with a maximum credible earthquake magnitude (MCE) of 7.9 and the Hayward Fault (15.9 Km east) with a MCE of 7.3.

There had been four soil borings taken at the site. Two of these were on the north side of the creek and the other two were on the south side on shore next to the abutments. The borings were driven 80-100 feet below ground surface. He explained that the log of borings showed soft clay soils around 30 to 40 feet below ground surface. More dense, stiff soils were found below 40 feet of ground surface. He explained that the borings with the soft clays showed the lowest plasticity index (PI) of 51 percent at boring B-3. He cited research for soft clay layers with a PI greater than 18 percent where liquefaction would not be a factor. After describing the development of the acceleration response spectrum, ARS, and the USGS Interactive Deaggregation Spectrum Design, he indicated that the liquefaction analysis indicated a total settlement of 0.6
inches on Boring B-1 at the abutment on the north side. At the abutments, a five-foot fill layer would be placed over the existing grade to correct the abutment angles for or to straighten the alignment of the proposed bridge. The additional five foot layer of fill would result in one and a half inches of settlement also creating an estimated downdrag of 45 kips for each of the 2-foot diameter CIDH abutment piles. Now Mr. Lee deferred to Mr. Han-Bin Liang to do the sea-level-rise and hydraulics presentation.

Mr. Liang began his presentation showing pictures used on the BCDC and USGS websites indicating the risk of sea level rise (SLR) over the region and most particularly the area of the project. The inundation levels on both sides of the proposed bridge present scenarios of 20 to 55 inches of flood levels between mid- and end-of-century. The scenarios used included SLR conditions that used the Mean Highest High Water (MHHW) level of 5.72 feet NAVD88 and 100-year flood water elevation (Q_{100}), adding 16 and 55 inches to MHHW and 100-year flood water elevation for SLR in 2050 and 2100, respectively. The three time scenarios (current, 2050 and 2100) included Q_{100} flowing against MHHW elevations with current, 16- and 55-inches. The water elevation comparison chart shown indicated the following conditions throughout the structure:

Water Elevation Comparison

Location	Top of Deck Elevation	Soffit Elevation	Q100 + MHHW	Q100 + MHHW + 16" SLR (2050)	Q100 + MHHW + 55" SLR (2100)
Abutment #1	13.22	7.72	9.1	9.3	10.9
Bent #2	14.87	9.37	9.1	9.3	10.9
Bent #3	17.73	12.23	9.1	9.3	10.9
Bent #4	18.31	12.81	9.1	9.3	10.9
Bent #5	16.43	10.93	9.1	9.3	10.9
Abutment #6	12.70	7.20	9.1	9.3	10.9

The water elevation above showed that top-of-deck elevations at the lowest point of the bridge, Abutments 1 and 6, at 13.22 and 12.70 feet NAVD, respectively, will be above flood levels through year 2100 taking into account SLR and 100-year storm conditions. However, the bottom-of-deck or soffit at elevations 7.2 and 7.72 feet NAVD would be underwater starting with current conditions of 100-year storms. This was the end of the presentation by the applicant's representatives.

Board Discussion. Dr. Gilpin began the discussion with an inquiry regarding the classification of the bedrock as depicted in the log of borings. The geotechnical report referred to a bedrock contact at Boring B-3; however, the log did not clearly showed this fact indicating that sampling at bottom of the probe at elevation minus 60 feet MSL indicated silty sand (SM)/sandstone, but then further down (elevation minus 63-65 feet) the sample was described as silty sand with gravel. Dr. Gilpin raised this concern so that the designers and the City retain some control over any cost overruns when unanticipated items are claimed after the bidding process. He pointed out similar details on Boring B-2 that indicated collected samples as "massive" and "more fractured", and indication of possible opposite categories. The log of borings and geotechnical assessment is critical on a project, for the structure foundations depend on them for meeting design criteria. He inquired further into the geotechnical report's reliance on a classification of the rock strength for the LPILE analysis (modeling of piling) of 40,000 psf. However, he did not find evidence in the logs that showed any such soils with this characteristic strength present throughout the site. Mr. Rollo continued on this topic with questions about liquefaction, downdrag, placement of fills in the abutment and any associated impacts. He opined that the site's soil strength conditions were much lower than 40,000 psf, and that in his opinion the designers should be addressing the downgrading of the strength values if the piles are to rely critically on any friction factors. The second comment regarded the project's estimates for downdrag loads of 45 kips. Mr. Rollo opined that assuming the clay of the bay mud was normally consolidated and that the thickness is about 40 feet thick, the average strength through that bay mud is around 300-400 psf. Based on that, he estimated that the downdrag load were about 80-100 kips of downdrag loads. He asked the applicant to look at that detail again. Mr. Lee explained that a stress reduction factor and Mr. Rollo was satisfied with the detail.

Mr. Rollo commented regarding settlement. Since the bridge segments would be constructed in stages, namely, building one bridge span at a time followed a year later by the second segment, he noted that the potential differential settlement could pose a problem of matching the two bridge structures acting separately and only later united by a joint and the abutments at their ends. Further, he noted that this could become a "conform" issue to be addressed, two halves of the structure that could not meet at the same elevations. Lastly, he commented on his concerns regarding potential missing factors driving the liquefaction analysis whereby he thought that the applicant underestimated the liquefaction potential. His opinion stemmed again from the samples descriptions in the logs showing a very thick layer of silty sands on Boring B-1, whose blow counts range from 5 to 21. He said he didn't know the plasticity index or PI of the silty sands. Therefore, he wanted to see these results of the logs addressed in the liquefaction analysis. The settlement issue discussed previously added to the concerns of a greater estimation for downdrag load greater than 45kips. He thought that the area would potentially liquefy, especially at ground accelerations of 0.67g (reference to the force of gravity) earthquake. He again suggested a calculation of it.

Mr. Lee opined that this silty sand characteristic of the soil at B-1 was not present elsewhere on the other borings and that this layer of sandy soil could be an isolated incident. Mr. Rollo countered that since there would be a pier near the location of the boring, it would be susceptible to a downdrag load. He reiterated his concerns about the potential settlement and downdrag load based on the findings of the B-1 boring.

Mr. Power continued with the liquefaction aspect and concerns already addressed by Mr. Rollo. The log of borings showed that the layer of silty sand, which would be susceptible to liquefaction was a very deep layer of 40 feet thick ranging from elevation -40 to -80 feet below ground. He suspected that based on the information, liquefaction would be a factor to deal with. He opined that perhaps the foundations would not be relying on such layer for friction capacity but that all the relying capacity would begin on the sandstone rock at the abutment at elevation minus 80 feet to be sufficient to sustain the structure. Mr. Rollo interjected to say that the design of this structure showed a reliance on the soils to bear 300 kips above the minus 80-foot rock elevation. Mr. Lee concurred that bearing would be transmitted down to the rock without dependence on the potentially liquefiable soils above it.

Further, Mr. Power pointed out the silty liquefiable-prone sand layer as a continuous shallow layer at about elevation minus 15 to minus 20 feet that extended from boring B-1 across most of the length of the bridge to boring B-3. This fact, he noted, gets into the issues of lateral spreading and liquefaction at the abutments not only due to liquefaction upon this particular layer but also combined with the softness of the clay present just below the sands. He suggested the applicant to look at this potential for hazards to assess any potential impacts to the abutments. Finally, he asked if Caltrans had any role in reviewing the design. Mr. Cermak said that the road was not in the State highway system, but that it would be reviewed by Caltrans since there are federal funds involved through FHWA (Federal Highway Administration). The City would be doing the internal review within the county, according to the City's public works director. Mr. Power

inquired whether Caltrans would agree with the shear velocities design of this project in order to develop the seismic spectrum since these were off from the prescribed Caltrans' design criteria. The City representatives said that Caltrans will be reviewing the project prior to final design for compatibility with the Department's criteria. The Board requested future evidence of it.

The Board reiterated the request that the applicant looked again at the potential for liquefaction and lateral spreading, issues based on the soil information. The Board inquired about the stability of the superstructure (beams and deck above the piles). Mr. Seyed-Madani responded that the superstructure was designed to tie-in pretty securely to the piles, with large deformation and displacement capacity versus demand but always adhering to no-collapse criteria.

From the Hydraulics perspective, Mr. Dornhelm had some concerns based on the fact that the proposed structure soffit would be about two feet lower than the existing one; therefore, his questions were regarding the revised analysis that showed the upstream face cross sections of the structure to the north as being overtopped with water. He specifically referred to the BCDC policies on Climate Change, Policy Nos. 2 and 3, that call for a risk assessment and adaptive management plans of the project to be drawn up if the project was expected to exist beyond mid-century. His inquiries were about protective measures that the City would be conceiving of to safeguard the area surrounding the bridge as well as contingency plans if SLR water levels happened to be realized or if these were at higher values than anticipated. He wondered if the City has planned to install levees in the future to protect the surrounding communities.

Mr. Liang responded that the US Army Corps of Engineers had the Corte Madera Creek under its scope of issues-solving, but the agency's concentration had been on the upstream portion of the creek and its efforts had not yet reached the area of the project. His comments were followed by questions about any changes in the water loadings of the structure as a result of higher water levels.

Mr. Seyed-Madani said that the proposed bridge was designed with belten suspenders system that would restrain the structure if it were to withstand a one-in-a-lifetime flooding event. Mr. Rollo asked whether there was something to be done upstream at the watershed that would suppress or mitigate the effect of any anticipated SLR water levels that would affect the area. Mr. LaClair of BCDC said that studies were undertaken for Corte Madera Creek. He said that the studies included ways of reducing the intensity of the water volumes. He also asked the applicant whether the bridge would be able to accommodate and withstand the water load of the potential flooding of the soffit. Mr. Seyed-Madani reiterated that the structure was designed to do take the 2050 and 2100 water level projections.

Professor Comerio asked whether Caltrans had any flood criteria for similar projects that would address such risks. Mr. Seyed-Madani said that the Department only provided seismic criteria. The applicant reps also noted that Caltrans criteria classified structures by the shape, form and level of importance of the structure.

Chair Borcherdt brought up the issue of seismic instrumentation as required by Policy No. 3 on the Safety of Fills. He asked of the possibilities of sensor installations at both ends and at the center of the bridge. The applicant was not aware of this requirement. The Director of Public Works thought that this was subject to negotiation. He recommended that the applicant meet with the California Geological Survey to work out a plan of action regarding installation of instruments explaining that its potential benefits would be significant. He indicated the instrumentation would be invaluable for measuring and assessing the response of the new structure during an earthquake. He indicated such information is needed to thoroughly assess the public safety of bridge in future larger earthquakes. . Mr. Shamsapour became very concerned about the cost of this effort as he thought that the federal grant given to the City to rebuild the bridge would not cover the installation of instruments. Chair Borcherdt thought that it would be likely for Caltrans and the FHWA to add the funds for the instrumentation plan knowing that its benefits outweigh the costs.

Chair Borcherdt solicited any further comments from the Board in the context that the project was at the 65 percent design completion stage. Mr. Rollo had many issues regarding the soils questions. He asked the applicant whether it would be more productive to respond in writing to all the questions raised at the meeting in lieu of another meeting. Mr. Rollo summarized a tentative motion to concur with the engineering criteria contingent on the following information to be provided:

a. The project should review and, if justified, re-evaluate conditions for downdrag loads, lateral spreading and liquefaction;

b. It should justify the strength of the rock in the soil strata for the anchoring of piles and justify the strength above the rock in computing capacities;

c. Considering the poor quality of rock, it should justify the strength of the rock classification (40,000 psf) as described in the geotechnical report;

d. It should provide an end-of-century adaptive management strategy for the bridge, assuming it is to remain in place beyond mid-century. Management strategy should include a hydraulics analysis for the 55-inch SLR case and include any other possibilities for flood protection levees or other structures to protect developed areas downstream of the bridge.

A separate condition was also motioned by Mr. Rollo that a seismic instrumentation plan be reviewed by the Board before and after issuance of permit. However, the ultimate plan strategy should be worked out between applicant and CGS and submitted to the Board for review and comments.

The two motions were seconded by Mr. Dornhelm. Chair Borcherdt entertained the motions to a vote. The motions passed with no abstentions.

5. **Board Discussion of the Proposed IMTT MOTEMS-Compliance Wharf Replacement.** Chair Borcherdt asked the audience and members of the applicant team to introduce themselves. At this time Mr. Rollo recused himself from participation due to any potential conflict of interest. Ms. Ellen Johnck introduced herself as the liaison between the permitting agencies and IMTT. Mr. Darryl Laxo followed to introduce the rest of the engineering design team. Mr. Bill Cook from

Manson, Mr. Erik Soderberg from Liftech, Mr. John Gouchon of Treadwell&Rollo, Mr. John Barrella, General Manager, Mr. Bill Bruin and Mr. Bill Rudolph of Simpson Gumpertz & Heger and Ms. Ellen Johnck, environmental permitting consultant.

Mr. Laxo related that in the year 2010, IMTT underwent a MOTEMS structural audit, which showed many deficiencies throughout the facilities. Many of these deficiencies have been addressed; however, the main timber structure remains out of compliance with MOTEMS requirements. Some of IMTT's consultant such as Engeo and Halcrow developed strategies to bring the main structure under compliance resulting in an agreement with CSLC. He described the relationship background of all the people involved in the team from the geotechnical and structural engineering people to the permitting consultants. He described the goal of the project to be compliant with MOTEMS regulations, to significantly improve its safety and limit downtime and, finally, to extend the life of the structure for another 50 years. The project featured a demolition of 20,000 square feet of existing timber wharf to be replaced with 10,000-square-foot structures and pipelines. The completed work at this time consisted of a 35-percent complete design that incorporated comments from CSLC on compliance with MOTEMS. He anticipated that with permitting process completed by the 4th quarter of 2012, construction of the new facilities should begin by 1st quarter of 2013 and completed by 2nd quarter of 2014.

Further, he described the project in three phases in order of priority. Phase 1 consisted of the installation of a new fire monitor and pump to the south east of the terminal to be in place by the 1st quarter of 2013. Phase 2A would carve out portions of the main wharf in order to install new platforms and a series of dolphins. This would be operational by the 2nd quarter of 2014. Lastly, Phase 2B would remove the remaining original timber structure between 2020 and 2030. He would defer the structural approach criteria to Mr. Rudolph.

Mr. Rudolph explained his role with Engeo to support the MOTEMS audit part of the project whereas Treadwell&Rollo is the geotechnical consultant working with Liftech in the Wharf's modification design/built team. T&R reviewed the work by Engeo and concurred with the site characterization, the liquefaction and lateral spreading analysis and some of the response spectra but modified them such that the T&R spectra are to be used. T&R would be the retained consultant going forward in the project.

Mr. Rudolph summed up the soil profiles of the site describing the groundwater conditions at approximately 10 feet below the existing grade fluctuating between Elevation 0 feet and 5 feet (MLLW). Further, he described the different layers from top surface to Elevation -100 feet (MLLW) on shore as imported fill (5- to 20-foot layer, Elevations 10 to 0 feet MLLW), Young Bay Mud, YBM, (a 5-foot layer of softer soils, Elevations 7 to -8 feet), clay, silt and sand deposits (about 25-foot layer, Elevation 0 to -25 feet), and finally Old Bay Mud (deep layer, Elevation -25 and below). Offshore, he said, the mudline has been greatly modified by dredging, and because the YBM have been removed completely from the site, the soil layer consist of imported fill to a thick layer of stiff alluviums (clay, silt, sands and gravel). He provided some history of the site, which related that the area in 1864 had been a shallow marshland. By 1915, the area began to be developed when the railroad initiated to do dredging and filling land for the line. By 1942, the Santa Fe

Channel had been fully developed and was being used as part of the Kaiser shipyards. By 1995, the channel has been in the current conditions. Engeo's assessment of the site had consisted on an evaluation for liquefaction potential, liquefaction-induced settlements, and its consequences and seismic slope stability. In turn, he said, T&R had adopted the original assessment and developed the four levels of seismic shaking criteria. His findings were that the potential for liquefaction was extremely limited and settlements were relatively inconsequential. In the same way, he explained, the slope deformations were going to be relatively small.

Mr. Gouchon explained that T&R had used the same attenuation relationships described in the Engeo report resulting in the development of the four earthquake levels (return period) of shaking. However, he mentioned that the difference between Engeo's and T&R lay in the methodology of the development of the site specific spectra. He then explained the modeling done as part of the soil analysis for the purpose of establishing criteria for the project. Mr. Gouchon deferred the structural criteria to Mr. Erick Soderberg.

Mr. Soderberg explained the general design criteria based on MOTEMS. He described the basic designed loads: dead and live, berthing and wind loads; buoyancy loads, on the other hand, would be negligible. He pointed out the earthquake loads will be based on Site Class E: performance Level I (minor or no structural damage/temporary or no operational interruption) with a 50 percent chance of occurrence in 50 years or a return period of 72 years, and Level II (Controlled inelastic structural behavior with repairable damage/prevention of structural collapse/temporary loss operations, restorable within months and prevention of major spill) with a 10% chance in 50 years or a return period of 475 years. The mooring and berthing systems would not be designed to resist the MOTEMS design tsunami. He described the construction strategies of the fire monitor platform, which would rely on a single large-diameter piles ranging from 36- to 72-inch-in-diamter pilings for support. The wharf platforms would follow a similar strategy and criteria. Large piles would be driven into the mudline, followed by the prefab structures and welded in place. The large piles would minimize down time and would be used for their stiffness properties to limit the lateral deflection in light of the piping system that would rely on it. As a result of the stiff pilings, for the Level II EQ, the inertia loadings, the stresses (elastic) will be below the yield stress.

Although there would be a solid concrete deck, the wharf structure would rely only on the platform steel frame for the earthquake loadings. The platform frame would also be stronger than the pilings to direct the yield stress above the pilings.

Mr. Soderberg held that the design life of the structure would be 50 years. The main structures would have cathodic protection for corrosion resistance. The design water levels against flooding had taken into account two water elevations for design: a tsunami as required for consideration by MOTEMS versus the BCDC criteria for flood risk that takes into account SLR, design wave and 100-year flood elevation for the life of the structure, which in this case was to year 2063. The controlling criteria were the tsunami levels as these were almost three feet above the 100-year flood elevation analysis (BCDC's requirement). Mr. Soderberg finished his presentation and invited the Board and all participants to open discussions.

Board Discussion. Dr. Gilpin began the Board's inquiry and ask whether there was a concrete lining along the shoreline of the Santa Fe Channel area as it was portrayed in the aerial photos. The applicant reps said that this was riprap proofing or a relative thin layer of concrete slurry over the shoreline protection. Prof. Comerio asked for clarification of the downtime aspect in relation to the construction strategy. Mr. Laxo mentioned that this downtime related to an operational one whereby operations of the wharf during construction of the terminal would be minimized. Chair Borcherdt asked Mr. Soderberg to identify the most significant earthquake issues regarding the project. Mr. Soderberg responded that one of the big issues was regarding limiting the movement of the pipelines; thus, the reason for using large-diameter piles. The Chair asked whether there would be other methods in place besides relying on limiting the movement of the structure to prevent the pilings from damage. Mr. Laxo and other applicant reps explained that the piping would be isolated from the areas of berthing via dolphins; thus, the system would separate the structures for berthing and loading as they would act as independent structures. The reps also said that the design criteria rely on limiting lateral displacement to six inches through the large-diameter pilings. There was further discussion on the issue of pipeline displacement limits and contingencies as concerns by the Board. The applicant reps argued that the system would have to meet rigorous MOTEMS requirements of safety and must be approved by CSLC. Chair Borcherdt asked what would happen if the design displacements were exceeded.

Dr. Gilpin, referring to Engeo's cross section of the static slope stability, brought up the issues of the uncertainties and potential hazards created during construction in the removal of the old piles and whether these could undermine the recently placed soft sediments of the slope along the shoreline. The original alluvium material had been dredged creating a steep cut filled in with recent relatively softer sediments. Extensive discussion regarding the issue of potential instability of the soils ensued. Mr. Rudolph explained the approach taken as being very conservative whereby the mass of the new piles deep into the OBM (dense soils) would be effective in withstanding any possible movement from the upper soil layers. He also described that the modeling used met the requirements of MOTEMS criteria. After an inquiry from the Chair regarding any effects from Loma Prieta earthquake and potential soft bay muds in the area, Mr. Rudolph opined that he didn't consider the area as prevalent soft bay muds based on the profiles just shown. Mr. Power's concerns were more about the soft soils slope whereby too much expectations of strength could have influenced the modeling, but he realized that it was not the case. He also asked whether he was using a high-risk level for the structural analysis. The answer was that it was both Level 1 and Level 2 EQ levels that drove the criteria. Mr. Bruin said that for this structure it was the higher level (475 years) that controls, but it was added that both earthquake performance levels were for higher risk cases. Finally, he asked whether the design would use the T&R design spectra, and the response was affirmative and that the latter company would be retained for consultation during the project. Mr. Power's concerned were assuaged as he opined that T&R's design spectra were more conservative than Engeo's.

Chair Borcherdt asked the potential for spills or leakages from the pipelines. Mr. Laxo said that the system had isolation valves that shut the system and isolate the intake in the piping length section. The worst case could be the volume loss of product from the isolated section. As

far as potential fires, most likely they would be at the wharf at the manifold, but the fire monitors onshore to provide deluge coverage for all the hardware and it would keep the fires away from and protect the storage tank.

Finally, the Chair asked about any plans for seismic instrumentation at the site. Mr. Bruin said that they had contacted SMIP (Strong Motion Instrumentation Program) already, and that the project was slated for a hearing at the next December SMIP Board meeting. The one concern was the agency's funding for installation of the sensors and their maintenance as IMTT had offered to provide the space. Further, he alleged SMIP did not show great interest since the project did not involve the construction of building, and marina terminals were not high priority. The applicant's representatives also expressed its willingness to provide the space for the instrumentation, but not necessarily the cost to run the instrumentation project due to the limited resources of the company. Further discussion on the benefits and potential location of the instruments ensued. The Chair asked BCDC to summarize its technical review request to the Board in relation to the project. Mr. Montes read part of the BCDC project summary, which indicated the objectives of the ECRB review in light of the agency's laws and policies, namely, a request to evaluate the project against the potential hazards, including flooding, and second request an evaluation of the site's suitability for installation of seismic instrumentation.

Prior to entertaining a motion for approval of the engineering criteria, the Chair solicited any other opinions/comments from the Board. The one contingency for approval would be that the applicant worked on preparing a seismic instrumentation plan that should be adopted, concurred by and in conjunction with CGS. The contingency motion as described came down to having an instrumentation plan drafted after the SMIP's December 2012 meeting that would possibly provide some funding for the instrumentation project at the site. The draft instrumentation plan should be submitted to the Board for review and approval.

Mr. Power moved the motion for approval of the engineering criteria, which was seconded by Dr. Gilpin. The motion passed with no abstentions.

6. **Adjournment.** There being no further old or new business, the meeting was adjourned at approximately 5:00 p.m.

Respectfully submitted,

RAFAEL MONTES
Board Secretary

Approved, with corrections at the Engineering Criteria
Review Board Meeting of June 10, 2014.